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NEWSPRINT FROM MIXTURES OF PHILIPPINE HARDWOODS

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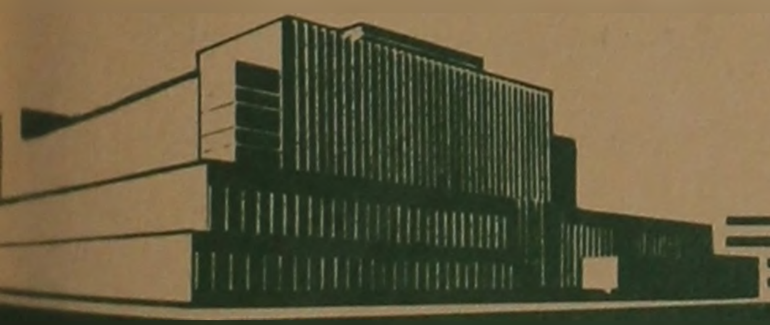
By,

James F. Laundrie
and
Donald J. Fahey

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AID Report No. 2



FOREST PRODUCTS LABORATORY
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UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
In Cooperation with the University of Wisconsin

NEWSPRINT FROM MIXTURES OF PHILIPPINE HARDWOODS

By,

James F. Laundrie
and
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U.S. Department of Agriculture

Summary

This report establishes the suitability of Philippine hardwoods for the manufacture of newsprint paper. Acceptable quality newspaper was made from (1) 100 percent Philippine hardwoods consisting of 70 percent thermomechanical pulp and 30 percent kraft and (2) 80 percent hardwood thermomechanical pulp and 20 percent long-fiber sulfite pulp.

Experimental

Wood Mixtures

Fifty species of Philippine hardwoods were used to make pulps for the newsprint paper machine trials. The chips were made from bark-free

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[1] Maintained in Madison, Wis. in cooperation with the University of Wisconsin.

wood in a commercial size, four-knife chipper. The nominal length of the chips was 5/8 inch and the fines and oversize were removed prior to blending of the individual species to obtain the mixtures. The mixture used to make the kraft pulp contained equal amounts (dry-weight basis) of 47 species listed in Table 1. As shown in Table 2, two different mixtures were used to make thermomechanical pulps. The first mixture contained equal amounts of the three lightest colored species while the second mixture contained equal amounts of the next five lightest colored species.

Kraft Pulping

Preliminary kraft pulping studies were made with mixtures of all 50 species combined in three different specific gravity distributions. Based on the results of these preliminary trials (see AID Report No. 1) the following conditions were chosen to make the pilot-scale digestions:

(a) 16.0 percent active alkali

(b) 25 percent sulfidity

(c) 4-to-1 water-to-wood ratio

(d) 90 minutes to raise the temperature to 170° C.

(e) 90 minutes at 170° C.

Using 140 pounds (dry weight) of chips for each, five pilot-scale digestions were made. At the end of cooking the digester was blown, and the resulting pulp was washed, screened through a 0.012-inch slotted flat screen, and wet lapped. The blend of the five pulps had a kappa number of 22.8.

Thermomechanical Pulping

The two mixtures of light-colored chips were converted into thermo-mechanical pulps at the pilot plant of C. E. Bauer, Springfield, Ohio. Both

chip mixtures were given an initial two-minute steaming at 30 p. s. i. g., and then fiberized to about 400 Canadian Standard freeness in a 418-pressurized refiner. These high-freeness pulps were returned to the Forest Products Laboratory (FPL) after the initial fiberizing in order for us to have better control and more flexibility in developing optimum properties of these pulps for use in newsprint.

Preliminary atmospheric refining trials made with these high-freeness pulps in a 36-inch disk mill indicated that it was necessary to lower the freeness to about 125 Canadian Standard freeness in order to develop optimum properties. Consequently, the larger batches of pulp for the paper machine trials were refined to about this freeness. Because the brightness of both pulps was too low for use in newsprint, they were bleached with hydrogen peroxide before being used in the paper machine trials.

Bleaching

The Philippine hardwood kraft pulp was semibleached to a brightness of 76.4 percent in a 3-stage bleach consisting of chlorination, extraction, and hypochlorite. The conditions of this bleach are given in Table 3.

The thermomechanical pulps made from the three- and the five-species mixtures were bleached to brightnesses of 66.1 and 67.2 percent, respectively, using a one-stage bleach of hydrogen peroxide. The conditions of these bleaches are given in Table 4. During the pressurized thermomechanical fiberizing stage, stresses are developed in the fibers. A recommended procedure for relieving these stresses is heating of the pulp slurry above 70° C. and agitating until a constant freeness is obtained. This "latency" was effectively removed from these thermomechanical pulps under the conditions used to make the bleaches.

Papermaking

Newsprint weighing 32 pounds/3000 square feet (52 grams/square meter) was produced on an experimental Fourdrinier paper machine from furnishes containing the thermomechanical pulps and either the Philippine hardwood kraft pulp, a western hemlock sulfite pulp, or a combination of these two pulps. The sulfite pulp, obtained from a West Coast newsprint manufacturer, was refined in a pump-through disk refiner to a Canadian Standard freeness of 600 milliliters and the Philippine hardwood kraft pulp was refined in the same equipment to 450 milliliters. For some of the runs the thermomechanical pulps were refined further in the pump-through in an attempt to improve the opacity and close up the sheet. The processed pulps were blended in the machine chest and the pH of the furnish adjusted to 4.5-5.0 with sulfuric acid and alum. Dye was added to the different furnishes approaching the "tint" of commercial news. Without the dye the sheets had a distinct yellow characteristic attributed to the thermomechanical pulp.

Evaluations

All tests were conducted according to TAPPI methods unless otherwise indicated in the tables. Printability of the newsprint was evaluated at the laboratory of a commercial newsprint manufacturer and is expressed in terms of print quality and strike-in.

Results

Pulp Properties

The handsheet properties of both the unbleached and semibleached Philippine hardwood kraft pulps are given in Table 5. As was found in

previous work with other tropical hardwood mixtures, the quality of these pulps was far better than that of kraft pulps made from North American hardwood mixtures. Bleaching of the Philippine hardwood kraft pulp with CEH lowered all strength properties only slightly. As shown in Table 6, the strength properties of the commercial western hemlock sulfite pulp were about equal to those of the bleached Philippine hardwood kraft pulp.

The handsheet properties of the bleached thermomechanical pulps are given in Table 7. Good quality pulps were made from both chip mixtures. The pulp made from the three-species mixture is lower in bursting and tensile strengths primarily because of its higher freeness which was lowered for the paper machine runs by additional refining.

Newsprint

Results for the various experimental newsprints are presented in Table 8. Samples of the papers are included in the report. For comparison, properties of commercial newsprint from the Philippines, Canada, and the United States have been included in the table.

The newsprint papers with the Philippine hardwoods had good strength characteristics generally in the range of the commercial papers. Acceptable newsprint was made from 100 percent of these hardwoods. Machine run 7107A with 70 percent thermomechanical pulp and 30 percent hardwood kraft had good strength properties and opacity. While its opacity was not as high as the commercial paper, it was somewhat higher in brightness. However, in terms of scattering power (scattering coefficient) it was as good as the newsprint from Canada and the United States. Its printing characteristics and smoothness were in the range of the commercial sheets.

Replacing part of the hardwood kraft with commercial softwood sulfite pulp (machine run 7109) had little or no effect on strength but did adversely affect printability, opacity, and smoothness. This sheet was comparable in strengths to the paper made with 80 percent thermomechanical pulp and 20 percent sulfite (machine run 7106). The printability and optical properties were better with the higher thermomechanical pulp level. The paper (machine run 7110A) with 88 percent thermomechanical pulp (remainder sulfite) did not have as good strengths as the other experimental papers, but its optical properties were the highest.

Refining the thermomechanical pulp in a third stage in the pump-through disk refiner resulted in a slight improvement in opacity. However, this did cause a slight loss in tearing strength. This did not seem to seriously alter the drainage characteristics on the paper machine.

Conclusions

1. It appears that acceptable newsprint can be made from 100 percent tropical hardwoods for the local markets but may require the addition of a small quantity of long-fiber pulp for the World market.

2. The hardwood thermomechanical pulp requires bleaching for use in newsprint and the newsprint furnishes need to be dyed to approach the tint of North American newsprint.

3. Printability and optical properties are better with higher levels of thermomechanical pulp.

Table 1.--Names and Specific Gravities of the Philippine Hardwood Mixture Used to Make Kraft Pulp

Common name	Botanical name	Specific gravity
Tangisang-bayauak	Ficus variegata	0.236
Binuang	Octomeles sumatrana	.242
Kapok	Ceiba pentandra	.244
Balilang-uak	Meliosma macrophylla	.260
Kaitana	Zanthoxylum rhetsa	.296
Ilang-ilang	Cananga odorata	.308
Anabiong	Trema orientalis	.319
Hamindang	Macaranga bicolor	.324
Balanti	Homalanthus populneus	.356
Mayapis	Shorea squamata	.366
Matang-arau	Melicope triphylla	.381
Malasantol	Sandoricum vidalii	.394
White lauan	Pentacme contorta	.401
Tulo	Alphitonia philippinensis	.422
Tangile	Shorea polysperma	.429
Pahutan	Mangifera altissima	.435
Apanit	Mastixia philippinensis	.447
Lago	Pygeum vulgare	.451
Antipolo	Artocarpus blancoi	.469
Bagtikan	Parashorea plicata	.478
Sakat	Terminalia nitens	.485
Red Lauan	Shorea negrosensis	.510
Itangan	Weinmannia luzoniensis	.526
Piling-liitan	Canarium luzonicum	.549
Palosapis	Anisoptera thurifera	.554
Lomarau	Swintonia foxworthyi	.559
Malabetis	Madhuca oblongifolia	.560
Dangkalan	Calophyllum obliquinervium	.568
Panau	Dipterocarpus gracilis	.576
Katmon	Dillenia philippinensis	.592
Batitinan	Lagerstroemia piriformis	.597
Katong-lakihan	Amoora macrophylla	.608
Narig	Vatica mangachapoi	.618
Miau	Dysoxylum euphlebium	.623
Apitong	Dipterocarpus grandiflorus	.623

Table 1.--Names and Specific Gravities of the Philippine Hardwood Mixture Used to Make Kraft Pulp--cont.

Common name	Botanical name	Specific gravity
Bok-bok	Xanthophyllum excelsum	0.639
Kamatog	Erythrophloeum densiflorum	.650
Dalingdingan	Hopea foxworthyi	.667
Katilma	Diospyros nitida	.679
Yakal	Shorea astylosa	.718
Kamagong	Diospyros philippinensis	.720
Katong-Matsin	Chisocheton pentandrus	.725
Manaring	Lithocarpus soleriana	.736
Ipil-ipil	Leucaena leucocephala	.737
Bolong-eta	Diospyros pilosanthera	.743
Makaasim	Syzygium nitidum	.778
Alupag-amo	Litchi philippinensis	.793

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Table 2.--Names and Specific Gravities of the Philippine Hardwood Mixtures Used to Make Thermomechanical Pulps

Common name	Botanical name	Specific gravity
	3-SPECIES MIXTURE	
Rarang	Erythrina subumbrans	0.264
Gubas	Endospermum peltatum	.316
Dita	Alstonia scholaris	.316
	5-SPECIES MIXTURE	
Binuang	Octomeles sumatrana	.242
Kapok	Ceiba pentandra	.244
Balilang-uak	Meliosma macrophylla	.260
Kaitana	Zanthoxylum rhetsa	.296
Ilang-ilang	Cananga odorata	.308

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Table 3.--Bleaching of Philippine Hardwood Kraft Pulp Used in Newsprint Trials

Stage	Chlorination	Extraction	Hypochlorite
Chemical - name	Cl_2	NaOH	NaOCl
- amount applied.....pct.	6.30	2.0	1.75
- amount consumed.....pct.	6.24	---	1.62
Temperature.....°C.	21	70	38
Consistence.....pct.	2.7	10.2	11.0
Duration.....min.	60	60	240
pH - initial	3.5	11.4	10.6
- final	3.2	11.2	9.4
Brightness.....pct.	---	---	76.4

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Table 4.--Bleaching of Philippine Hardwood Thermomechanical Pulps for Use in Newsprint Trials

Species mixture	3	5
Chemical[1] - name	H_2O_2	H_2O_2
- amount applied, pct.	.72	.84
- amount consumed, pct.	.64	.79
Temperature, °C.	71	72
Consistence, pct.	9.8	10.1
Duration, min.	120	120
pH - initial	10.0	10.0
- final	9.0	9.0
Brightness - original, pct.	54.7	51.5
- final, pct.	66.1	67.2

[1] Additional chemicals used were 3 percent $NaSiO_3$, 2 percent NaOH, and 0.05 percent $MgSO_4$.

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Table 5.--Handsheet Properties of Unbleached and Semibleached Mixed Philippine Hardwoods Kraft Pulps Used in Newsprint Trials

	Unbleached				Semibleached			
Beating time.....min.	0	14	27	42	0	11	25	33
Freeness (CSF).....ml.	615	505	390	240	570	490	350	255
Burst factor.....	32	54	70	82	26	48	64	70
Tear factor.....	116	121	115	108	117	117	108	108
Breaking length.....km.	6.8	9.7	10.6	12.3	5.1	7.9	9.7	10.4
Apparent density.....g./cc.	.56	.62	.66	.70	.60	.65	.69	.72
Brightness.....pct.	25.1	---	---	---	76.3	---	---	---

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Table 6.--Handsheet Properties of Commercial Western Hemlock Sulfite Pulp Used in Newsprint Trials

Beating time.....min.:	0	15	23	30
Freeness (CSF).....ml.:	700	485	375	225
Burst factor.....:	22	55	61	65
Tear factor.....:	148	88	92	80
Breaking length.....km.:	5.2	8.9	9.6	10.0
Apparent density.....g./cc.:	.62	.71	.71	.73
Brightness.....pct.:	47.5	---	---	---

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Table 7.--Handsheet Properties of Mixed Philippine Hardwoods Thermomechanical Pulps Used in Newsprint Trials

Species mixture	3	5
Freeness (CSF).....ml.	170	105
Burst factor.....	7.0	11.4
Tear factor.....	39.6	32.6
Breaking length.....km.	2.2	3.0
Apparent density.....g./cc.	.42	.45
Brightness.....pct.	66.1	67.2
Scattering coefficient.....	655	673
Opacity.....pct.	90.0	91.4

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Table 8.--Properties of the Newsprint Papers

Machine run No.	Furnish[1]					Physical properties																
	Philippine hardwood			Western hemlock sulfite[4]	Weight		Thick-ness	Den-sity	Bursting strength	Tearing resistance		Tensile strength		Opacity	Scattering coefficient	Bright-ness (Elrepho)	Air resis-tance (Gurley)	Smooth-ness (Bekk)		Printing quality		Strike in
	TMP[2]		Kraft[3]		square meter	(24x36--500)				Machine direc-tion	Cross direc-tion	Machine direc-tion	Cross direc-tion					Wire	Felt	Tones	Solids	
	3 species	5 species	47 species																			
	Pct.	Pct.	Pct.	Pct.	G.	Lb.	Mils	G./cc.	Pts.	G.	G.	P.i.w.	P.i.w.	Pct.		Pct.	Sec./100 cc.	Sec.	Sec.			
EXPERIMENTAL NEWSPRINT																						
7106	80	---	---	20	52.2	32.1	3.2	0.54	9.4	19.2	24.0	11.9	5.4	87.4	494	58.1	11.0	19.4	19.6	4.6	4.0	12.5
7104A	80[5]	---	---	20	51.1	31.4	4.1	.49	8.2	21.6	23.9	10.0	6.0	86.1	505	59.4	7.2	15.2	15.7	---	---	---
7109	70	---	20	10	49.1	30.1	3.7	.52	8.7	17.8	23.6	13.0	5.5	85.8	504	59.6	8.3	14.8	18.0	5.0	4.6	14.9
7105	70[5]	---	20	10	50.7	31.2	3.9	.51	9.2	23.3	25.6	11.4	5.3	85.0	489	61.9	6.0	15.8	16.8	4.7	4.1	16.7
7107A	70	---	30	---	51.1	31.4	3.6	.55	10.4	17.5	21.4	13.7	5.6	89.8	487	61.4	10.7	20.2	21.4	4.8	3.3	13.3
7108	25	25	50	---	52.0	32.0	4.0	.51	10.2	20.2	23.4	13.0	6.0	88.0	549	64.2	10.2	16.4	17.2	4.2	3.4	13.3
7110A	---	88	---	12	48.7	29.9	3.9	.49	7.1	12.6	17.8	11.3	5.0	90.8	610	60.9	12.2	16.1	17.2	3.8	3.1	12.6
COMMERCIAL NEWSPRINT																						
Philippine					52.0	32.0	3.6	.56	7.5	18.8	21.0	7.8	3.8	96.2	660	45.3	---	--	--	---	---	---
Canadian					55.5	34.1	3.5	.62	6.0	14.6	20.8	10.7	4.6	91.2	456	54.6	16.7	25.5	31.0	5.0	5.6	12.1
U.S. - Southern - Machine run 5651					59.0	36.3	3.8	.61	9.6	35.0	40.2	12.0	6.3	93.1	486	57.6	55.5	23.2	22.7	7.4	7.1	12.8

[1] All furnishes contain dye.

[2] Thermomechanical pulp.

[3] Refined in pump-through disk refiner to 450 milliliters Canadian Standard freeness.

[4] Refined in pump-through disk refiner to 600 milliliters Canadian Standard freeness.

[5] Not refined. Thermomechanical pulp refined in all other runs to approximately 100 milliliters Canadian Standard freeness in pump-through disk refiner.


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